

REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have cancelled all of the previously considered claims 1-9 and 11-18, and are adding new claims 19-30 to the application. Of these newly added claims, all claims are directed to a process for recovering ditrimethylolpropane by-produced when producing trimethylolpropane by reacting n-butyraldehyde with formaldehyde in the presence of a basic catalyst, and then separating trimethylolpropane by extraction and distillation. The claims then go on to define the process of ditrimethylolpropane for recovering ditrimethylolpropane. Claim 19 recites that this recovery process includes the steps of adding hydroxylamine salts to a still residue of the distillation (used in separating the trimethylolpropane); subjecting a formal compound contained in this still residue to acid decomposition in the presence of the hydroxylamine salts, at a specified temperature using at least one of a mineral acid and an organic acid; and then recovering the ditrimethylolpropane after the acid decomposition. Claim 20, dependent on claim 19, recites that the ditrimethylolpropane is recovered from acid decomposition products in the still residue after the acid decomposition.

New independent claim 21 recites that the recovery process of ditrimethylolpropane includes removing high-boiling components having a higher boiling point than that of ditrimethylolpropane by distillation, from a still residue of the distillation for separating trimethylolpropane; after removing the high-boiling components, subjecting a formal compound contained in the still residue to acid decomposition; and subjecting the resulting products of the subjecting step to

crystallization using a solvent. Claims 22 and 23, each dependent on claim 21, respectively further defines the removal of the high-boiling components and further defines the acid decomposition; and claim 24, dependent on claim 23, recites that at least one compound selected from the group consisting of alcohols and hydroxylamine salts is added to the still residue together with the acid, for the acid decomposition.

Claim 25 recites that the recovery process of ditrimethylolpropane includes subjecting a still residue of the distillation for separating trimethylolpropane to crystallization using a solvent; after the crystallization, subjecting a formal compound contained in the still residue to acid decomposition; and subjecting the resulting products after the step of subjecting the formal compound to acid decomposition to crystallization. Claims 26 and 27, respectively dependent on claims 25 and 26, respectively further defines the acid decomposition, and recites that the acid decomposition is performed using an organic acid. Claim 28, dependent on claim 25, recites that at least one compound selected from the group consisting of alcohols and hydroxylamine salts is added to the still residue together with the acid, for the acid decomposition.

Claim 28 recites that the recovery process of dimethylolpropane includes subjecting a formal compound contained in the still residue (of the distillation for separating trimethylolpropane) to acid decomposition; removing high-boiling components having a higher boiling point than that of ditrimethylolpropane, by distillation, from the still residue; and subjecting the resulting products after removing the high-boiling components to distillation for removal of low-boiling components. In connection with claim 28, note previously considered claim 14. Claim 29, dependent

on claim 28, recites the further step of performing crystallization, using a solvent, after removal of low-boiling components by distillation, in step iii) of claim 28. In connection with claim 29, note, for example, previously considered claim 15.

Applicants respectfully traverse the rejection of their claims under the second paragraph of 35 USC 112, as set forth on page 2 of the Office Action mailed July 31, 2002, particularly insofar as this rejection is applicable to the claims as presently submitted for consideration by the Examiner. Thus, note that claim 19 recites that ditrimethylolpropane is recovered from the still residue after the acid decomposition.

It is respectfully submitted that claim 19 clearly provides a tie-in between the step of recovering ditrimethylolpropane and the step of acid decomposition. Moreover, note that claim 21 recites a step of subjecting a formal compound contained in the still residue to acid decomposition, whereby resulting products of the acid decomposition are formed, with these resulting products being subjected to crystallization using a solvent. Note similar language in claim 25 (tying in the acid decomposition step to the crystallization of step iii). Claim 28 corresponds to previously considered claim 14, which was not rejected under the second paragraph of 35 USC 112. In view of the present amendments to the claims, it is respectfully submitted that there is a clear tie-in between the step of recovering dimethylolpropane and the step of acid decomposition, such that the claims are clearly complete and satisfy requirements of the second paragraph of 35 USC 112.

Applicants respectfully submit that all of the claims now presented for consideration by the Examiner patentably distinguish over the teachings of the reference as applied by the Examiner in rejecting claims in the Office Action mailed July 31, 2002, that is, the teachings of Great Britain Patent Document

No. 1, 292,405 (GB '405), under the requirements of 35 USC 102 and 35 USC 103.

It is respectfully submitted that this reference as applied by the Examiner would have neither taught nor would have suggested such a process for recovering dimethylolpropane by-produced when producing trimethylolpropane as in the present claims, including, inter alia, wherein hydroxylamine salts are added to a still residue of the distillation utilized in separating the trimethylolpropane, with formal compound contained in this still residue being subjected to acid decomposition in the presence of the hydroxylamine salts, ditrimethylolpropane being recovered from the still residue after the acid decomposition. See claim 19.

Furthermore, it is respectfully submitted that this reference as applied by the Examiner would have neither taught nor would have suggested such process as in the present claims, including, inter alia, wherein high-boiling components having a higher boiling point than that of the ditrimethylolpropane are removed by distillation from a still residue of the distillation for separating trimethylolpropane; and, after removing the high-boiling components, a formal compound contained in the still residue is subjected to acid decomposition, resulting products of this acid decomposition being subjected to crystallization using a solvent. See claim 21.

Moreover, it is respectfully submitted that the reference as applied by the Examiner would have neither taught nor would have suggested such process as in the present claims, including the removal of high-boiling components prior to the acid decomposition, and wherein such removal of the high-boiling components is performed by molecular distillation. See claim 22.

In addition, it is respectfully submitted that this applied reference would have neither disclosed nor would have suggested such a recovery process of

ditrimethylolpropane as recited in the present claims, this recovery process including subjecting a still residue of the distillation to crystallization prior to conducting the acid decomposition, with the resulting products of the acid decomposition being subjected to crystallization. See claim 25.

Moreover, it is respectfully submitted that the teachings of the applied reference would have neither taught nor would have suggested the presently claimed process, including wherein the acid decomposition is performed using an organic acid. See claim 27.

Furthermore, and noting the indication by the Examiner in the Office Action mailed July 31, 2002 as to allowability of the subject matter of claims 14-16, it is respectfully submitted that claims 28 and 29 should be allowed.

In connection with the subject matter of present claim 19, Applicants have found that by adding, for example, hydroxylamine salts to the still residue, which salts are present during the acid decomposition reaction, formation of ditrimethylolpropane-derived cyclic formal (CDF) can be avoided, so that the dimethylolpropane can be produced at a high yield. That is, the hydroxylamine salts act as a scavenger for decomposed products during the acid decomposition reaction, so that a high quality dimethylolpropane can be obtained at a high yield. Note, for example, page 9, lines 17-22 of Applicants' Specification.

In addition, by removal of the high-boiling components having a higher boiling point than that of dimethylolpropane, prior to the acid decomposition, color components remaining after the acid decomposition can be avoided. These color components are difficult to remove after the acid decomposition.

Furthermore, by performing this removal of high-boiling components having a

higher boiling point than that of ditrimethylolpropane, by molecular distillation, large amounts of steam are not necessary for the distillation (compare with GB '405, which utilizes vacuum steam distillation and requires drainage of large amounts of material). According to the present invention, the amount of drainage is small because steam need not be added at the time of removal of the high-boiling components having a higher boiling point than that of ditrimethylolpropane, due to using molecular distillation.

In addition, by removing high-boiling components having a higher boiling point than that of ditrimethylolpropane by crystallization using a solvent, prior to acid decomposition, as in claim 25, more complete removal of high-boiling components having a higher boiling point than that of ditrimethylolpropane can be achieved, as compared with use of distillation.

Furthermore, by the present invention, using an organic acid for the acid decomposition of the formal compound, as in claim 27, rather than using a mineral acid, strong acids can be avoided. By avoiding the strong acid, reduced corrosion of plant equipment, and a wider selection of material for the plant equipment, is accomplished.

GB '405 discloses a method of purifying ditrimethylolpropane, particularly that formed as a by-product in the production of trimethylolpropane by reacting n-butyraldehyde with formaldehyde in an aqueous medium in the presence of an alkaline catalyst. This patent discloses that when crude ditrimethylolpropane material (containing various formals) is heated together with methanol in the presence of an acid catalyst, there occurs an acetal exchange reaction between the added alcohol and the formals so that the formals of ditrimethylolpropane are

converted into ditrimethylolpropane, with a result that ditrimethylolpropane can be isolated and purified easily. See page 1, lines 9-15. Note, also the paragraph bridging pages 2 and 3. Note also page 3, lines 20-26. This patent further discloses that after the reaction, the acidic catalyst is neutralized with a suitable alkaline substance such as sodium hydroxide, potassium hydroxide or calcium hydroxide and then any remaining alcohol is distilled away. See page 3, lines 43-47. This patent also discloses the use of vacuum distillation with superheated steam either prior to or after the reaction in the presence of the acid catalyst. See the paragraph bridging the left-hand and right-hand columns on page 3.

Initially, in connection with claim 19, it is respectfully submitted that GB '405 is silent with respect to adding hydroxylamine salts. Clearly this reference would have neither taught nor would have suggested such aspect of the present invention, and advantages thereof as discussed in the foregoing.

Furthermore, with respect to that aspect of the present invention set forth in claim 21, the high-boiling component having a higher boiling point than that of ditrimethylolpropane are removed by distillation before the acid decomposition, having the advantage of removing coloring components which disadvantageously effect the final product, these coloring components being difficult to remove after acid decomposition. Particularly in view of this advantage, and noting, for example, Example 1 of GB '405 disclosing addition of methanol and concentrated sulfuric acid directly to the crude ditrimethylolpropane, it is respectfully submitted that this reference would not have disclosed nor would have suggested the prior removal of high-boiling components and advantages thereof.

Furthermore, note that GB '405 utilizes vacuum steam distillation. Note, for

example, Example 4 of GB '405. This vacuum steam distillation requires relatively large amounts of steam, resulting in a large amount of drainage necessary in the method of GB '405. In comparison, the amount of drainage according to the present invention is small, due to use of molecular distillation, because steam is not added at the removal of high-boiling components. It is respectfully submitted that GB '405 would have neither taught nor would have suggested this aspect of the present invention (that is, use of molecular distillation as set forth in claim 22), and advantages thereof.

It is respectfully submitted that GB '405 is silent with respect to removal of high-boiling components by crystallization using a solvent, as in claim 25. The applied reference would have neither taught nor would have suggested this aspect of the present invention and advantages thereof, wherein removal of the high-boiling components is more completely achieved.

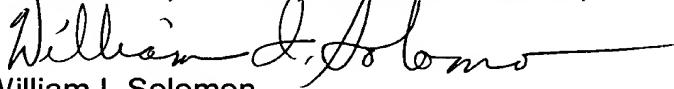
Furthermore, it is emphasized that GB '405 utilizes a strong acid such as sulfuric acid. It is respectfully submitted that a strong acid is needed in GB '405, because in this applied reference the acid neutralizes (and is neutralized by) sodium formate contained in the high-boiling components. It is respectfully submitted that an organic acid such as p-toluenesulfonic acid can be used according to the present invention, because the high-boiling components have been removed before acid decomposition. By use of a relatively weak acid, corrosion of plant equipment can more likely be avoided, with greater flexibility of selection of material for the plant equipment. It is respectfully submitted that GB '405 would have neither taught nor would have suggested the aspect of the present invention as in claim 27, and advantages thereof.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently in the application are respectfully requested.

To the extent necessary, Applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to the Deposit Account No. 01-2135 (Case No. 396.40405X00), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

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